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INVESTIGATION OF GRID FIELDS WITH A MINIATURE IONIZATION CHAMBER

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Radiation therapy through perforated shielding gives rise to a very inhomogeneous dose superficially and a somewhat inhomogeneous dose distribution at a depth. Such a distribution has been found to make possible a more effective treatment of some tumors than conventional X-ray therapy.^{1,2,3,4}

The grid field was first used by Kohler⁵ but received but sporadic interest until recently. Grids presently used are constructed of lead-rubber or lead, backed with aluminum or lucite. They have either square or circular holes from 0.5 to 1.5 cm. in size, and usually have 40 to 50% open area. Measurement of the depth dose under such grids poses problems. Densitometric measurements have been made on a number of grids by Cohen and Palazzo⁶ and there is little doubt that the method gives one a good picture of the distribution; however, quantitative data is still difficult to obtain by this method. Jolles and Mitchell⁷ have measured the distribution with small condenser chambers in a pressed wood phantom. The ionization chambers were about the same diameter as the holes in the grid, so that no idea of the change of dose across the holes could be obtained. Lipman and Jacobson^{8,9} used a 250 r Victoreen chamber for their measurements in the 200 to 400 KVP range. Loevenger¹⁰ used a 4 mm. by 9 mm. ionization chamber held perpendicular to the beam in a water phantom for his measurements.

Loevenger found that "the essential information about grid depth doses can be computed from standard depth dose tables". At a given HVL, FSD, and depth the contribution of scatter to the central axis dose in an open field is calculated as follows. The zero area depth dose is subtracted from the back scatter factor times the depth dose for the field area and depth under consideration. The difference is the scattered portion which will be reduced by the presence of the grid, by a factor which is approximately equal to the ratio of the open area to the total area of the field. The shielded areas will receive this scattered radiation, while the open areas will receive in addition the direct radiation

given by the zero area dose. This method has been found to describe the results obtained at 200 Kev. by Lipman and Jacobson and by Loevenger.

Loevenger's method does not indicate the magnitude in the drop in intensity at the edge of the field nor does it indicate the shape of the maxima or minima. Wheatley and Worthley¹¹ have indicated that they have computed the fields with their computer and have found that "the scatter varies smoothly across the field with no discontinuities at the holes".

A method analogous to Clarkson's¹² may be used to yield a more accurate description of the field from the point of view of detail. Scatter was plotted as a function of radius from the back scatter factors¹³ and the depth dose figures of Johns¹⁴. These curves were differentiated and divided by $2\pi r$ to give the scatter per unit area at the radius r . The contributions from each hole were then summed to give the resultant at the point under investigation.

Depth dose tables have been calculated for a focal skin distance of 50 cm., using this method. (Table 1.) The grids used for the calculation had 1 cm. diameter holes every 1.4 cm. to give 40% transmission. Fields were square and of such a size as to include an integral number of holes. Areas of 50 cm.², 100 cm.², 225 cm.², and 440 cm.² were used. For each area the dose received at 0, 1, 2, 5, 10, 15 cm. depths is given as compared with 100 in air for half value layers of 1.0, 2.0 and 3.0 mm. of copper. The depth dose is given for four different positions beneath the grid; at the centre of an opening and at the centre of a shielded area midway between four openings both in the middle and at the edge of the field. The effective area of the holes at the periphery will be reduced by the angulation of the beam through the grid. A correction for this effect and for the transmission through the grid material is not included in the table as it is usually small and varies with the material from which the grid is constructed.

A small ionization chamber, Fig. 1, was built in order to study the fields experimentally. The inside diameter of the air wall cap was 1.5 mm. and its length was 6 mm. A thin central aluminum wire coated with aquadag, to make the chamber wavelength inde-

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TABLE 1
CALCULATED DEPTH DOSE DATA FOR 40 PERCENT TRANSMISSION LEAD GRID
AT A F. S. D. OF 50 cm.

The grid has 1 cm. diameter holes every 1.4 cm.

Depth	Area 50 cm ²				Area 100 cm ²				Area 225 cm ²				Area 440 cm ²			
	Centre of field		Edge of field		Centre		Edge		Centre		Edge		Centre		Edge	
	in beam	out beam	in beam	out beam	ib	ob	ib	ob	ib	ob	ib	ob	ib	ob	ib	ob
<i>Half Value Layer 1.0 mm. Cu</i>																
1	111.7	9.4	109.4	8.6	114.4	12.1	110.6	10.3	15.7	117.9	112.3	11.7	17.9	120.1	113.4	12.7
2	100.7	16.7	97.0	14.7	104.9	20.8	98.5	16.6	26.0	109.8	101.2	18.1	28.5	113.1	102.2	19.3
5	87.7	18.9	82.4	16.6	92.2	23.5	84.7	19.4	28.9	97.2	87.3	21.2	32.0	100.4	87.9	22.6
10	53.3	17.1	49.3	14.8	58.1	21.6	51.6	17.9	28.2	64.0	54.8	20.4	32.3	68.0	57.4	22.8
15	22.9	9.2	20.8	8.2	26.1	12.4	22.5	10.4	17.4	31.3	25.4	12.5	20.5	35.2	27.9	14.5
15	9.6	4.5	8.6	4.1	11.4	6.1	9.3	5.4	9.3	14.7	11.3	6.8	11.9	17.7	13.2	8.2
<i>Half Value Layer 2.0 mm. Cu</i>																
1	110.9	8.0	108.4	6.8	112.8	10.5	109.4	8.6	13.9	115.9	111.5	10.0	16.1	118.5	113.0	11.2
2	99.2	13.6	95.9	11.9	102.6	17.1	97.3	14.2	21.5	106.5	99.8	15.9	24.1	109.6	101.7	17.5
5	87.3	15.8	83.7	13.8	91.1	19.9	85.5	16.6	24.8	96.1	88.7	18.7	28.4	99.8	90.6	20.7
10	54.0	14.2	51.0	12.2	58.5	19.1	53.2	15.2	25.6	64.0	56.7	17.7	29.6	69.0	59.2	20.1
15	24.1	8.7	22.6	7.5	27.4	12.1	24.3	9.8	17.4	32.5	27.2	11.9	21.2	36.0	29.1	13.7
15	10.4	5.2	9.8	3.8	12.7	7.0	10.9	5.3	10.3	16.0	12.8	6.7	12.5	18.4	14.0	8.1
<i>Half Value Layer 3.0 mm. Cu</i>																
1	109.1	6.5	106.2	5.8	111.1	8.5	107.1	7.1	11.3	113.9	109.6	8.1	12.8	115.5	110.5	9.3
2	97.7	11.7	94.9	10.3	100.5	14.5	96.1	12.2	18.2	104.1	97.7	13.5	20.1	105.9	98.7	14.7
5	86.1	13.4	82.9	12.0	89.2	16.6	84.3	14.0	21.0	93.4	86.4	15.6	23.7	96.3	88.0	17.4
10	54.8	13.1	52.0	11.0	58.0	17.0	53.5	14.2	22.7	63.0	56.6	16.1	26.2	67.0	58.5	18.3
15	25.1	7.9	23.3	7.0	28.0	10.9	24.9	9.1	15.8	32.8	27.4	10.6	19.1	36.1	29.4	12.4
15	11.4	4.3	10.4	3.7	13.3	6.2	11.4	5.1	9.4	16.4	13.2	6.4	11.3	19.0	14.7	7.9

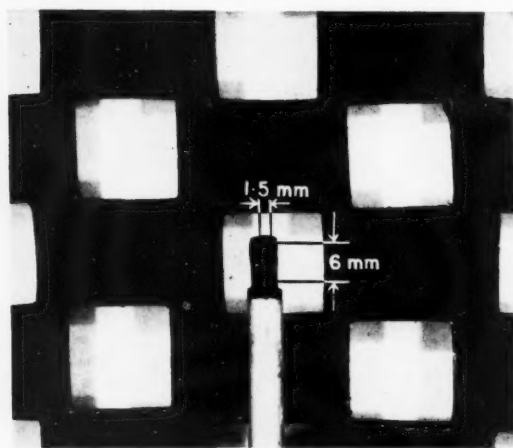


Fig. 1.

Photograph of ionization chamber under a typical grid with dimensions shown.

pendent, passed down through solid polystyrene to the preamplifier. The chamber could be moved remotely and its position indicated to 0.1 mm. Transits were made across beneath a number of grids at depths of

1, 5, 10 and 15 cm. For most transits the ion chamber was rotated through 90° from the position shown in Fig. 1 and would appear in Fig. 1 as a circle with inside diameter 1.5 mm. A chamber held in this way introduced some error in depth dose measured along the axis. To overcome this, a flat shallow chamber 1 mm. deep and 3 mm. in diameter was used. Using data obtained by these two chambers, the results illustrated in Fig. 2 were obtained.

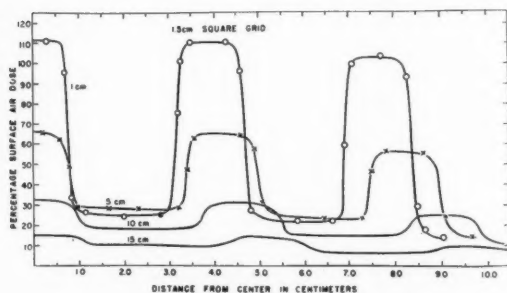


Fig. 2.

Typical transits at depths of 1, 5, 10 and 15 cm. H.V.L. 1.5 mm. copper, grid openings 1.5 cm x 1.5 cm, Area 400 cm², F.S.D. 50 cm.

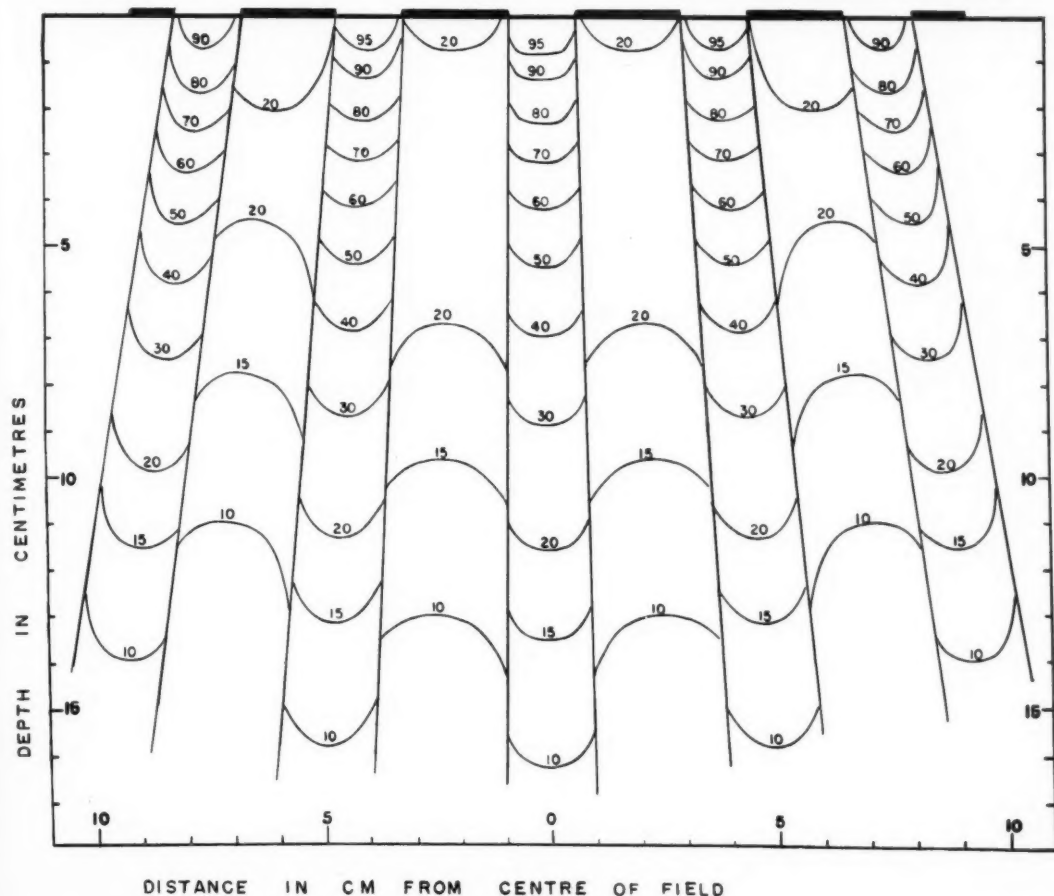


Fig. 3.

Experimental Isodose Curves H.V.L. 1.5 mm. Cu. grid openings 1.5 cm. x 1.5 cm., area 400 cm², F.S.D. 50 cm.

The sharp discontinuities expected have been somewhat lost by the size of the ionization chamber and the size of the target of the X-ray machine. An isodose curve drawn, after correcting for the former of these effects, is given in Fig. 3.

A comparison of our theoretical calculations with those obtained by Loevinger's method and with a typical observed transit is shown in Fig. 4. Loevinger's method gives good agreement at the centre although the maxima are slightly smaller and the minima slightly larger, a result of the non-uniformity of the scatter across the field. All of our experimental results taken under a variety of conditions agree with the theoretical calculations summarized in Table 1.

Jacobson's depth dose values at 400 Kev. do not agree with our tabulated values. Depth dose measurements were made at two widely separated field areas and were found to agree closely with calculations at this energy.

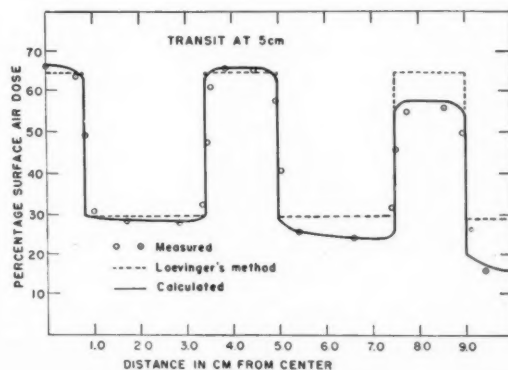


Fig. 4.

Experimental and theoretical transits at 5 cm. depth. Two theoretical curves are shown, one obtained by Loevinger's method and the other by detailed calculation based on Clarkson's method.

Although the scattered contribution of the dose varies evenly across the field, it is larger beneath an opening than beneath the lead. For this reason, Loevenger's method, which assumes a constant scatter, gives values that are slightly too small beneath the central openings and values that are slightly too large below the lead. An even distribution of scattered radiation would be more closely approached with a greater number of small perforations in the grid. The error in the use of Loevenger's method for the grids considered seldom exceeded 5% for a point under an opening and 10% under a shielded region. This difference may be considered small enough to be clinically insignificant.

Conclusions:

Depth dose measurements with grids have been made with very small ionization chambers. The results are in good agreement with those obtained by detailed calculations based on depth dose tables. For clinical purposes Loevenger's method is satisfactory for evaluating the dose distributions near the central axis.

Acknowledgements:

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ANNOUNCEMENT

The James Picker Foundation has announced the award of nine Grants and two Fellowships in Radiological Research for the coming year. These awards, totaling approximately \$42,000, were made on recommendation of the Committee on Radiology of the National Academy of Sciences — National Research Council.

The Picker Foundation was established in 1947, with the objective of fostering research in and broadening the scope of radiology. With the cooperation of the Academy — Research Council, the Foundation initiated its program of research grants and fellowships in 1950. Since that time, grants have been made in support of investigations in nine laboratories in this country and in three foreign institutions. An additional grant has been made for support of a Scholar in Radiological Research, and fellowships have been awarded to four young scientists to enable them to advance their preparation for investigative careers in the field of radiology.

MALIGNANT DUODENAL COLIC FISTULA

A Case Report

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Malignant duodeno-colic fistula is quite uncommon. The case reported here is the twenty-second in the available literature, and is the fourth occurring in a female.

These patients present a rather striking clinical picture with sudden onset of severe, persistent diarrhoea with occult blood and often undigested food in the feces; severe weight loss; some abdominal discomfort; and marked impairment of nutrition and anemia. The case to be presented shows these features and is of additional interest in that successful radical surgery was carried out. However, death occurred five months later, apparently from a cerebral accident.

Case History:

The patient (no. 443) was a forty-six year-old white female admitted to the Kingston General Hospital for investigation on 12 January 1953, with the following complaints:

1. Diarrhoea — Persistent and watery for the last seven weeks.
2. Weight loss — 34 lbs, in sixteen weeks.
3. Abdominal cramps — of moderate severity.

Past History:

No previous attack related to gastro-intestinal tract. Petit mal attacks since age 14. Abdominal hysterectomy three months ago (Oct. 8, 1952) because of irregular abnormal vaginal bleeding for three years. The specimen showed leiomyomata and adenomyosis uteri; atrophic endometrium; chronic cervicitis; fibrosis of appendix.

Present Illness:

Some days after the abdominal hysterectomy she, as well as several other patients, developed diarrhoea. She still had some diarrhoea when discharged from hospital. This, however, persisted and became more severe in the seven weeks prior to re-admission. Movements were watery in consistency and occurred about twelve times daily.

There was progressive weight loss in spite of a good appetite and food intake. She went from her usual weight of 105 lbs down to 71 lbs.; 24 of the 34 lbs. were lost in the seven weeks prior to admission to the Kingston General Hospital.

She had some abdominal cramps, but they were not very severe in type, and seemed to occur after carbonated beverages.

Clinical Investigation:

The patient was a very thin anemic female. No abnormal masses were palpated in the abdomen. T.P.R. were normal. Blood pressure was 88/60.

The Stool: — loose — not formed — light brown in color — extremely foul odor — contained food particles — 4 plus for occult blood — no ova or parasites — contained 21 grams of fat per day (31% of total dry weight).

The Blood Examination: — hbg. 9.8 grams; RBC 3,440,000 — WBC 6,100 — Sed. Rate 29 mm. in 1 hour — hematocrit 33% — hypochromia and anisocytosis — normal platelets — normal differential count.

There was hypoproteinemia. Total serum proteins=5.11 grams %, albumen 2.44 grams % — globulin 2.67% — A.G. Ratio was 0.92. The N.P.N. and Serum Sodium, Potassium and Chloride were within the range of normal.

Radiological Investigation:

9 January, 1953: An examination of the colon was attempted in another city, but the patient was not satisfactorily prepared. They were unable to rule out the possibility of a lesion in the region of the hepatic flexure and suggested repeat examination after further cleansing. (Mention is made in the report of some radio-opaque material in the stomach at the beginning of the examination — believed due to Bismuth patient was receiving for diarrhoea.)

Patient was then admitted on 12 January 1953 to the Kingston General Hospital for further investigation.

Stomach:

An examination of the stomach, duodenum, and small bowel was carried out. No abnormality was seen until the barium reached the second portion of the duodenum, which filled, but then showed an extension of the barium from the duodenum, across into the hepatic flexure of the colon, and then filling up the caecum and ascending colon.



Figure 1

The duodenal loop filled, but none could be seen going into jejunum, probably because of the fact that the barium so readily passed into the hepatic flexure of the colon from the second portion of the duodenum. There was a loop of bowel crossing the abdomen to the site of the fistula, which at this time was suspected to be jejunum. Barium reached the rectum in one-half hour. A barium enema examination was recommended, and was carried out two days later.

Colon:

At this time the barium flowed freely from the hepatic flexure across through the fistulous tract into the second portion of the duodenum and back into the stomach. This latter barium in the stomach then passed through the duodenal loop into the jejunum, but follow-up films for the small bowel did not suggest that there was any further abnormal connection between the small bowel and fistulous area in the right upper quadrant.

Radiological Conclusions:

The constant abnormality in the region of the hepatic flexure of the colon was suspected to be an intrinsic neoplasm, with secondary fistula formation into the duodenum, resulting in a complete short-circuiting of the small bowel.

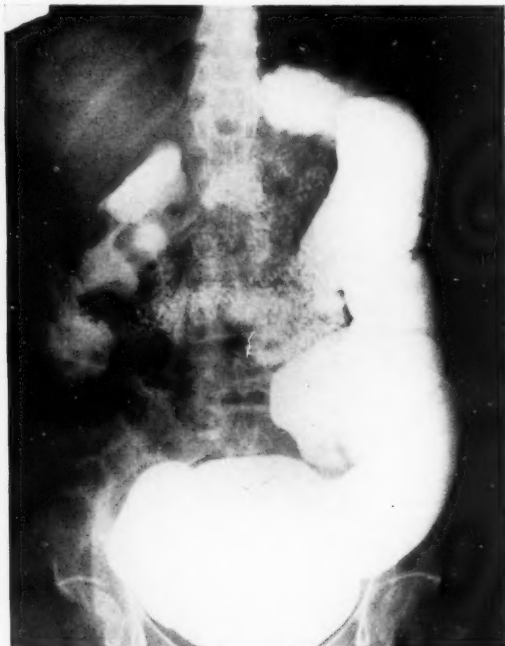


Figure 2

Operative Report: (Dr. D. L. C. Bingham)

At operation on January 29th, 1953, a large mass in the region of the hepatic flexure, firmly adherent to the second part of the duodenum and the pancreas was found. This mass was mobilized and since the liver and omentum appeared to be free of secondary deposits, a radical procedure was decided upon and carried out at one stage. In this, part of the stomach, the entire duodenum, a portion of the pancreas, the ascending and transverse segments of the colon were removed. The cystic duct was anastomosed end to end to the proximal jejunum. A gastrojejunostomy was carried out. An end to side anastomosis between the pancreas and jejunum was made between the above two anastomoses, and finally, the distal ileum anastomosed to the descending colon.

Pathological Examination: (Dr. G. F. Kipkie) Gross:

The specimen when opened presented a large ulcerating tumour mass which measured 5 cms. in diameter at the junction of the duodenum, ascending colon and a portion of the small bowel which appeared to be jejunum. The tumour was situated about 8 cms. beyond the pylorus.

Microscopic:

The examination revealed a well differentiated adenocarcinoma. The cells are tall columnar, mucous secreting in type, exhibiting pseudo stratification of the nuclei, hyperchromatism and moderate number of mitoses. Tumor of the same histological type is seen in the duodenum, and there it appears to come from the outside, although the duodenal mucosa is replaced in area noted in the gross, by the malignant process.

Similarly, the end of the bowel attached to the mass is invaded by tumor and the tumor is present in the large bowel.

No metastases were found in lymph nodes despite the widespread local extension.

Follow-up:

The patient's general condition was satisfactory at the completion of the surgery. Post-operatively she had a somewhat stormy course, but gradually improved and was discharged from hospital on 22 Feb. 1953. She was seen again two months later and seemed very well indeed. She had regained 21 lbs and was having 1-2 bowel movements per day, which were bulky but normally colored stools. Five months postoperatively we understand she apparently suffered a cerebral accident, and died in a couple of days without regaining consciousness. Unfortunately, no autopsy permission was obtained.

Discussion:

Duodenal colic fistula is most frequently due to carcinoma of the colon, but is an uncommon yet spectacular complication.

E.P. Hall-Drake and J.F. Goodwin¹ record two additional cases due to carcinoma, besides the nineteen mentioned by Hershenson and Kirsner². Benign lesions were responsible for the remainder, and peptic ulcer was the most common underlying lesion in this group³. The characteristic clinical picture in malignant duodenal colic fistula is well-demonstrated in the case presented, namely —

- Persistent severe diarrhoea.
- Marked weight loss and weakness.
- Abdominal distress (mild to moderate).
- Undigested food and occult blood in feces.

— Hypoproteinemia and disturbed food absorption as shown for example in plasma protein level and anemia.

In cases due to benign lesions, diarrhoea often is absent, and weakness and weight loss are less severe.

Radical treatment is possible in only about one-third, due to the advanced stage of disease and poor condition of the patient. The longest survival in the literature was ten months. Our case survived five months.

Conclusions:

A sudden onset of persistent watery diarrhoea with extreme weight loss and wasting in a patient in middle life, accompanied by anemia and evidence of disturbed food absorption are the outstanding clinical features. Radiological examination, especially barium enema, usually demonstrates the underlying carcinoma and fistula.

This case is believed to be the twenty-second proven case of malignant duodenal colic fistula, and the fourth in a female, in the available literature.

Acknowledgements:

I am indebted to Dr. Malcolm Brown and to Dr. D.L.C. Bingham for permission to present this case, to Dr. G.F. Kipkie for confirmation of the pathology, and Mr. Phil Mott of the Audio-Visual Department for the excellence of the slides and reproductions.

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An excellent review of this condition including an extensive bibliography is given by Hershenson & Kirsner.

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PHEOCHROMOCYTOMA

A Case Report

by

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Pheochromocytomas are rare tumours of the adrenal gland whose presence can be detected clinically by the history and examination of the blood pressure. Radiological examination has until recently been non-contributory. Occasional cases have been reported since 1921 when Carelli introduced peri-renal insufflation to outline the kidneys, and 1935 when Cahill¹ applied the same technique to outline the adrenals.

A recent modification of the above technique by Ruiz Rivas² has simplified outlining the kidney and adrenal, and has already brought to light many cases of renal and adrenal pathology.

The procedure is fairly easy and requires simple equipment. A puncture is made into the presacral retroperitoneal space with a spinal puncture needle or standard intramuscular injection needle depending on the size of the patient. A gloved finger in the rectum acts as a guard against puncturing the rectum. The needle puncture is usually made at the level of the anococcygeal raphe, and the needle brought upward, inward and forward to the anterior aspect of the coccyx. The usual precautions about entering blood vessels are observed.

A few cc's of air are injected; if the flow is easy, 1000 cc's or more can be injected. Some discomfort may be complained of by the patient toward the end of the injection.

Routine anteroposterior and lateral films should be taken. Intravenous pyelography may be done and planigraphy alone or in combination with pyelography is recommended. Some radiologists insist on planigraphy every time this procedure is undertaken.

Case History;

Miss F. T., age 33, came into Hospital on the 24th of April 1953, complaining of severe headaches, nausea and vomiting which came in cyclic bouts. These symptoms had been present for over five years, but had become acute in the last four months. Headache was almost constant. Blood pressure readings on admittance showed a wide fluctuation from 240-140 systolic in the course of a minute or so. Because of this striking finding which was verified repeatedly, consideration was given to the diagnosis of pheochromocytoma.

A benzodioxane test was done and though the first test was unsatisfactory, the second test showed a lowering in the systolic pressure of about 40 mm. of mercury. This was considered a positive test.

Plain films of the abdomen and intravenous pyelograms showed no abnormality. Two retro-peritoneal air insufflations were done. The first showed air on the left side, but this was an advantage as proven later because localization as to side was improved. A definite tumour mass was noted in relation to the upper pole of the left kidney. (Figs. 1 and 2.) This mass lay in relation to the upper pole of the left kidney, spleen and stomach and was definitely not part of any of these structures. This mass could be seen in the lateral view to cap the kidney. The second insufflation outlined both sides well and confirmed the presence of the left-sided tumour.



Fig. 1

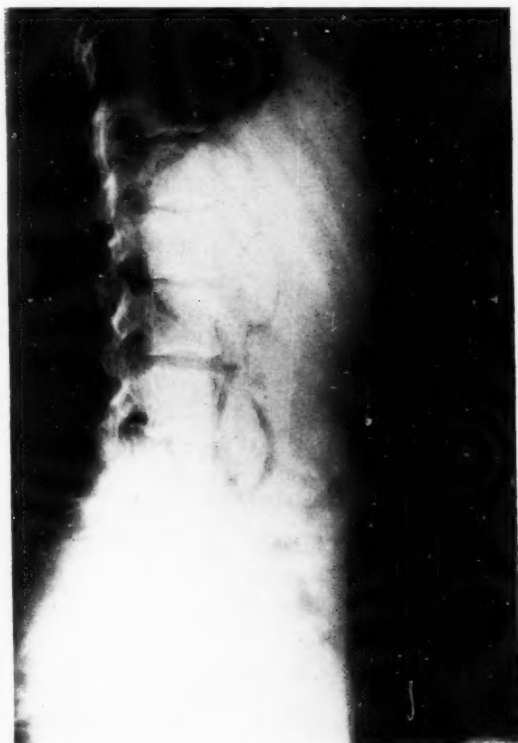


Fig. 2

At operation on the 10th of June 1953, by an anterior left-sided approach, a large tumour measuring 9 x 7 x 4 cm. was removed from the region of the left adrenal gland.

Immediately post-operatively the blood pressure dropped to 120-130 systolic over 80-90 diastolic. Since the operation, blood pressure readings have been normal.

The post-operative course in hospital was uneventful.

Pathologist's Report

The specimen consisted of an adrenal tumour which weighed one hundred and eighty grams. On the cut surface, the tumour showed



Fig. 3

a mottled appearance with greyish-yellow areas alternating with extensive zones of hemorrhage.

The microscopic sections (Fig. 3) showed a variable picture with large sheets of cells, some of which were polyhedral and showed a slightly vacuolated cytoplasm and others showed a stellate appearance. Sections from the material fixed in Orth's fluid showed the typical screening reactions from chromatin. A pathological diagnosis of pheochromocytoma of the adrenal gland was made.

Summary:

The case of a young woman with intermittent hypertension in whom a pheochromocytoma was found at operation is presented. Although the diagnosis was made clinically, radiological confirmation by the new technique of retroperitoneal air insufflation was possible.

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OPACIFICATION OF A CALCIFIED LEIOMYOMA DURING HYSTEROSALPINGOGRAPHY*

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The purpose of this paper is to report an unusual roentgen finding during hysterosalpingography—the opacification of a calcified uterine fibroid.

Case Report

On September 20, 1952 L. H., a thirty-three year-old white female, was admitted to the hospital for treatment of menometrorrhagia. The first episode of excessive vaginal bleeding occurred in May, 1952, at which time her periods lasted ten days instead of the usual five. In both June and July the flow was again prolonged, being nine days in each month. Clots were passed two weeks before the onset of the July catamenia.

Past History: The menarche occurred at the age of twelve. Her periods were regular, with an interval of twenty-eight days and a flow of five days. Six years ago she had a normal delivery at term. A routine postpartum examination at that time revealed the presence of uterine fibroids. As she was asymptomatic, surgical intervention was not advised. In 1949 her local physician performed a cauterization of the cervix because of a leucorrhea.

Physical Examination: The patient appeared rather pale, and was weak from blood loss. The temperature, pulse and respiration were normal. The blood pressure was 120/80. Bimanual examination revealed enlargement of the uterus to the size of an eight-week gestation. Firm nodules could be palpated on the uterine surface. The cervix was enlarged. A moderate flow of blood through the external os was noted.

Laboratory Examination: The erythrocyte count on admission was 3.69 million with 10 gm. of hemoglobin. The leucocyte count was 11,000 with 58% neutrophils, 38% lymphocytes, 2% monocytes and 2% eosinophiles. The hematocrit was 35%. A catheter specimen of urine on September 23 was straw-colored in appearance and had an alkaline reaction. The specific gravity was 1.001. A faint trace of albumin was found. The urine showed 50-70 w.b.c. and 5-10 r.b.c. per high power field. Occasional clumps of w.b.c. were noted. The serology was negative.

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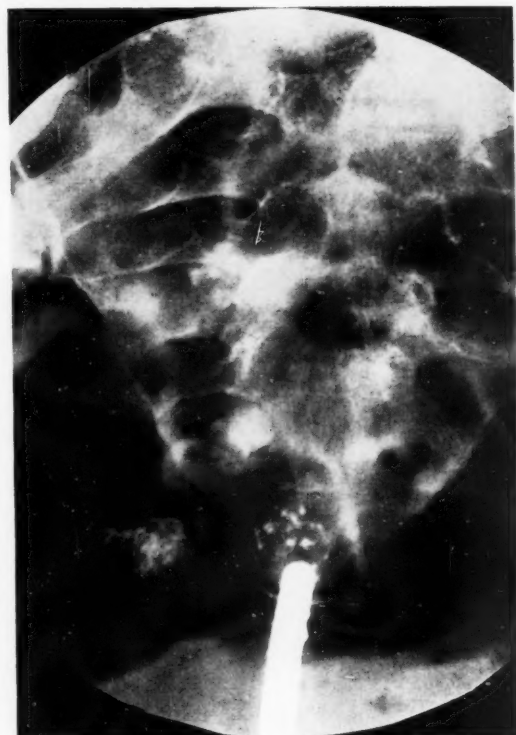


Fig. 1.

Preliminary plain film of pelvis with tenaculum and cannula in position. Tiny droplets of lipiodol are present near the tip of the cannula. The sacral density obscures the upper calcified fibroid in this photograph.

Roentgen Examination: A hystrogram was performed on September 24, 1952 with the fractional instillation of lipiodol. A preliminary plain film (Fig. 1) revealed the presence of two calcifications within the pelvis. One was projected over the third sacral foramen on the right side. It had a stippled configuration due to tiny calcific deposits extending over an area one cm. in diameter. The second was situated four cm. inferior to the other. It measured 1½ cm. in diameter and appeared to be composed of closely-grouped concretions. The uterine cavity was enlarged, requiring twelve c.c. for complete filling. The distal portion of the left tube appeared to be slightly dilated. No oil entered the right tube.



Fig. 2.

Hystero-gram with 8 c.c. of lipiodol. A shallow filling defect is noted on the right side of the corpus. The left cornu is depressed.

The radiograph taken after injecting eight c.c. of lipiodol (Fig. 2) revealed asymmetrical filling of the fundus with depression of the left cornu. A shallow filling defect in the corpus on the right side of the oil contour was noted. When twelve c.c. of lipiodol was introduced (Fig. 3), an inexplicable finding was observed. The contrast medium had opacified the right-sided calcification.



Fig. 3.

Hystero-gram with 12 c.c. of lipiodol. Opacification of the calcified fibroid occurs.

Twenty-four hours after the hystero-gram, a plain film of the pelvis was taken (Fig. 4). There was free oil in the peritoneal cavity. Only a few droplets of oil still persisted in the region of the right-sided calcification.

Roentgen Diagnosis: Enlarged uterus with leiomyomata; pelvic calcifications, possibly within fibroids; patent left tube with slightly dilated distal portion; cornual occlusion of right tube; unexplained opacification of pelvic calcification with lipiodol.

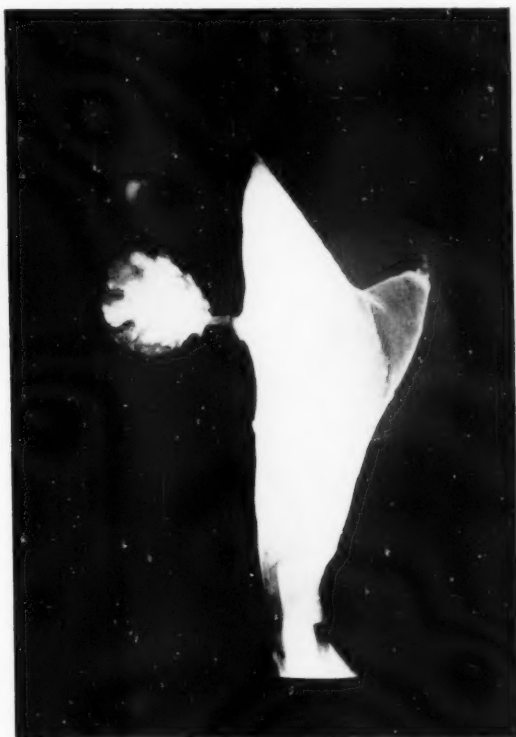


Fig. 4.

Hystero-gram (oblique view) of excised uterus. A sinus tract is demonstrated from the endometrial cavity to the calcified fibroid, with opacification of the fibroid.

Clinical Course: The patient was given sedation and placed on complete bed rest. Blood transfusions were administered because of the anemia. The pyuria suggested the presence of pyelonephritis, and gantrisin (sulfisoxazole)¹⁹ was prescribed.

The pre-operative clinical diagnosis was fibromyomata uteri and chronic cervicitis.

On September 25, 1952 a laparotomy was performed. The surgeon reported the uterus to be enlarged to that of a 10-12 weeks' gestation. Its surface was studded with small subserous fibroids both anteriorly and posteriorly. A corpus luteum cyst was present in the right ovary, and this was punctured. No gross abnormality of either tube was observed. A total hysterectomy and a prophylactic appendectomy were performed.

A roentgen study of the excised uterus was very informative. A plain film revealed the presence of two calcified areas in the specimen. A stippled calcification was visible in a knob-like protrusion from the fundus. A denser calcification was projected within the uterine substance.

Lipiodol was then injected into the uterine cavity. The corporal calcification became impregnated with lipiodol. A sinus tract was demonstrated from the calcification to the uterine canal.

Gross Pathology: Numerous bulging masses distorted the surface and shape of the uterus. A subserous nodule, measuring $1\frac{1}{2}$ cm. in diameter, was situated in the fundus. Section of this nodule revealed the presence of caseous material and numerous calcified bodies, each the size of a rice grain. On opening the uterus the left cornu was found to be the seat of several discrete nodules situated within the myometrium. On being cut, they bulged outwardly. Intramural nodules were also visible in the corpus. One of these was calcified. When this nodule was cut, fluid escaped. The calcification was noted to be in the form of closely packed flakes. The endometrium was finely granular in appearance and 3 mm. thick.

Microscopic Findings: The nodules in the myometrium were composed primarily of smooth muscle cells, arranged in interlacing bundles. The connective tissue stroma was abundant. Focal areas of fibrosis, edema, necrosis and calcification were evident in the myomata. The cervical stroma was the seat of an infiltration by lymphocytes and plasma cells.

Pathological Diagnosis: Leiomyomata uteri with degeneration and calcification; chronic cervicitis; proliferative phase of endometrium.

Post-operative Course: The patient had an uneventful recovery. Gantrisin (sulfisoxazole) was administered to prevent a catheter cystitis. She was discharged from the hospital on the twelfth post-operative day.

Discussion

The roentgen diagnosis of a uterine fibroid from a plain film study of the pelvis is not unusual since 1.7 per cent of uterine leiomyomata undergo calcification¹. One must, however, differentiate calcified myomata^{6,12,24} from other radiographic densities in the female pelvis^{20,21,27}.

Uterine fibroids may become symptomatic due to degeneration and pressure necrosis of adjacent myometrium, endometrium or other pelvic viscera. A subserous fibroid may ulcerate the endometrium and be evacuated vaginally²⁶; an intramural fibroid of the anterior wall of the uterus may perforate into the bladder^{10,28}; a subserous fibroid may break off into the peritoneal cavity^{3,17}. In this pa-

tient the degenerated fibroid evidently caused a localized pressure necrosis of the adjacent myometrium and endometrium, thereby forming a sinus tract into the uterine cavity.

Hysterographically, sinus tracts leading into the uterine cavity may be caused by previous curettage³, adenomyosis¹⁴, or endometrial tuberculosis^{9,23}. A large ulceration may be the result of an endometrial carcinoma¹⁶. Feathered borders of the contrast medium along the greater portion of the uterine contour are usually due to a hyperplastic endometrium^{8,15}. A serrated border confined to the cervical region is observed either in hypertrophied palmate folds¹³ or in a chronic endocervicitis⁷.

The pathological examination confirmed the belief that multiple leiomyomata caused the hystero-graphic findings^{4,11,22} of uterine enlargement and fundal deformity. The shallow defect on the right side of the oil column in the corpus, however, was not due to any budding fibroid or endometrial polyp in that area. It may have been due to a blood clot at this site.

The failure to fill the right tube was probably due to occlusion of its interstitial portion by the encroachment of intramural fibroids¹⁸. The slight dilatation of the left tube noted on the hysterosalpingogram was not evident at operation. Since the tubes were left in situ, pathological verification on this point is not available.

The etiology of the patient's menorrhagia is best explained by the presence of multiple uterine leiomyomata. It is believed that these tumors interfere with the uterine contraction that normally stops bleeding at the end of a menstrual period²⁵. An endocrine imbalance may be the underlying cause of both the fibroids and the menorrhagia^{25,29}. Intermenstrual bleeding with the passage of clots is only occasionally observed in a patient with a fibroid uterus².

Summary

A new roentgen observation during hysterosalpingography, the opacification of a calcified leiomyoma, is presented. This finding was the result of a sinus tract from the fibroid to the uterine cavity.

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MEETINGS

Eighteenth Annual Meeting of the Canadian Association of Radiologists will be held in the Chateau Laurier, Ottawa, January 10th-12th, 1955.

Arrangements have been made for the Annual Congress of the British Institute of Radiology, 1954-55 Session, to take place in the week commencing November 22nd, 1954.

The scientific meetings will be on the 24th, 25th and 26th November, in the Lecture Room of the New Horticultural Hall, Vincent Square, London, S.W.1. and in the Drill Hall of the Westminster Dragoons, Elverton Street, London, S.W.1. The scientific exhibition will be housed in the Old Horticultural Hall.

The programme of the Congress is being planned on similar lines to the previous years with symposia on diagnostic, therapeutic, physics and radiological subjects, with the Mackenzie Davidson Memorial Lecture on the evening of November 25th and a Dinner on the evening of November 26th.

The Fifth Inter-American Congress of Radiology, April 24th-29th, 1955, Washington, D.C., offers an extraordinary opportunity for graduate education. Immediately before the meeting of the Congress the American Radium Society will hold its annual meeting in the same hotel, namely the Shoreham Hotel, and immediately following the Congress there will be a short refresher course in radioactive isotopes offered by the National Cancer Institute.

Everyone who contemplates attending the Congress is urged to apply at once for membership to secure hotel reservations.

POSITIONS AVAILABLE

A vacancy exists for a certified English-Speaking Radiologist to take charge full time of the X-ray Department of a 121-bed general hospital in Quebec City. New 150-bed hospital under construction. Terms on application. Apply to: Administrator, Jeffery Hale's Hospital, Quebec City, Que.

Position Vacant — Radiologist wanted, 600-bed general teaching hospital — Department recently expanded. Basic salary plus percentage of gross revenue. Sister Superior, Ottawa General Hospital, Ottawa, Ont.

